Perspective on Wind Forecasting Research Needs

Workshop on Research Needs for Renewable Energy
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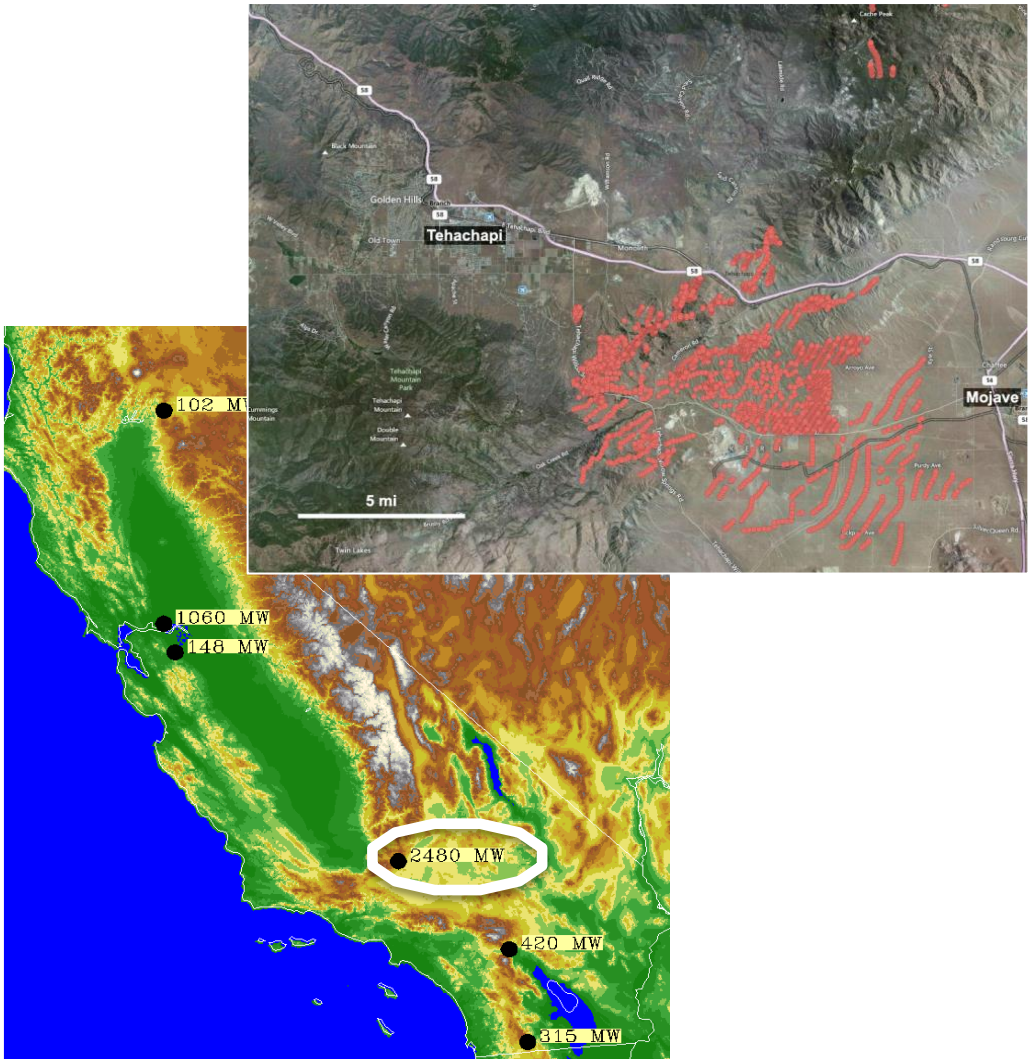
Perspective on Wind Forecasting Research Needs

- Observation based on on-going project focused on improving short-term wind power forecasting through measurements and modeling
- Project team (leads):
  - UC Davis
    - Case van Dam, Shu-Hua Chen
  - AWS Truepower
    - John Zack, Joseph Lefevre
  - Sonoma Technology Incorporated (STI)
    - Clinton MacDonald
- Project funded by CEC under EPIC. Additional funding by EPRI

Project Goals & Objectives

- Complete a forecast sensitivity error analysis to identify and quantify the parameters that most significantly impact wind ramp forecast errors.
- Conduct measurement campaign in the Tehachapi Wind Resource Area (TWRA), focused on the phenomena that drive wind ramps.
- Implement improvements to computational modeling of flow physics at low-levels in complex terrain (Weather Research and Forecasting method, WRF).
- Implement statistical and empirical methods to make very short-term correlations between meteorological measurements and wind turbine and wind plant production.
- Incorporate the improvements to WRF and the statistical and empirical correlations described above into a state-of-the-art wind power forecast system.
- Validate the modeling improvements for low-levels in complex terrain and immediately incorporate them into forecasts of wind power and wind power ramps in the TWRA provided to the California Independent System Operator (CAISO).

Tehachapi Wind Resource Area



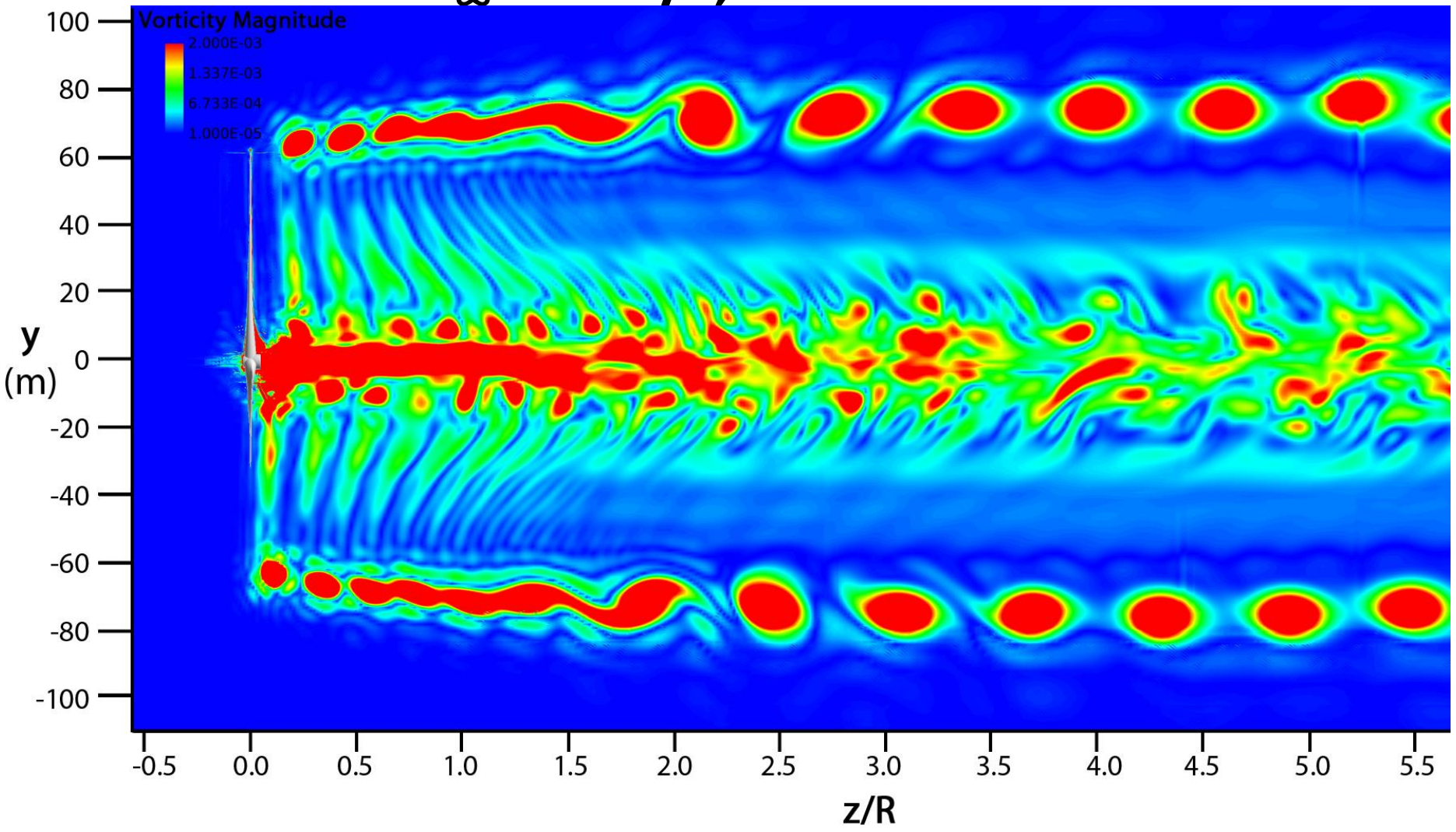
- California's largest wind resource area, both in existing capacity and potential
- More than 3.2 GW installed capacity
- Additional 1.5 GW in CAISO interconnection queue
- More than 8 GW potential (CEC IAP, 2007)
- Very complex terrain and meteorology

Research Needs

- Detailed benchmark data sets for validation of tools
- Improved numerical modeling of atmospheric boundary layer (Zack, Chen)
- Improved atmospheric sensing techniques (MacDonald)
- Improved modeling of wind turbine wakes and turbine to turbine interactions in mesoscale models such as WRF.
  - Current model uses parameterization based on turbine rotor drag which varies with wind speed.
  - Parameterization represents far-wake flow of rotor (> 5-10 rotor diameters).
  - Lack of detailed turbine info often results in use of idealized performance characteristics.
  - Near-wake flow of rotor extends over significant distance (0.5 – 1.5 km) for current and future turbines, is very different from far wake, and because of its strong vortical content, can have major impact on atmospheric flow development.
  - Far-wake model limits horizontal grid resolution in WRF.

NREL 5-MW Rotor Near-Wake

U_∞=11 m/s, TSR = 7.13



Source: Raymond Chow, OVERFLOW2